Chapter 5 Mainline Detector System

Data from vehicle detection technology is used in real time for FMS applications and may also be stored for planning purposes. The FMS gathers and uses real-time traffic data including speed, occupancy, vehicle identification, and volume. Recorded data is also useful for non-real time traffic planning purposes such as monitoring traffic trends and generating other traffic related statistics. This guide does not address detector data collection for traffic planning purposes.

5.1 Overview of Detection Technology

The principal vehicle detection system for the ADOT FMS has been loop detectors that are either sawcut into the pavement surface or installed beneath the PCCP pavement. At certain locations (usually in retrofit or loop failure situations) non-intrusive detection systems have been installed rather than sawcutting in new in-pavement loop detectors.

Non-intrusive detection technologies may be considered for FMS projects provided they have been approved by the ADOT TTG (see Section 3.1). Where new vehicle detection system technology is being proposed on a project, the designer needs to define and document the vehicle detection system technology and communications approach. This documentation should occur at a progress meeting no later than two months after the Stage II (30%) project submittal.

At a minimum the vehicle detection system needs to test for vehicle volumes, speed, occupancy, and identification. The project Special Provisions shall contain, in detail, the specific type of detection technologies required on the project and how acceptance testing will be conducted.

5.1.1 New Installations

Mainline detector stations are required for the entire urban freeway system. One detector loop station is required per mile in each direction adjacent to the entrance ramp input detectors (refer to the *Ramp Meter Design, Operations, and Maintenance Guidelines*). Preformed detector loops shall be embedded in all new concrete pavement. Sawcut loops are allowed in asphalt pavements. Each set of detector loops normally consists of two 6 feet x 6 feet square-shaped preformed detector loops per lane, separated longitudinally by 12 feet. Each preformed loop consists of five turns. All preformed loops shall terminate in a No. 7 pull box with extension at the shoulder. The No. 5 pull box, often used in the past, has proven to be too small in most applications.

Non-intrusive detection system technology is often used on retrofit projects (see Section 5.1.2). Planning and providing for future non-intrusive detection system technology supporting infrastructure is recommended for new installations. Where feasible, non-intrusive detection system technology is preferably located beyond the outside shoulder of the freeway instead of in the median barrier. New freeway installations should provide supporting infrastructure at a nominal cost for future non-intrusive detection system technology on both sides of the freeway. Typically, this infrastructure consists of a conduit system (a minimum of two 3-inch conduits) from all non-intrusive detection system technology foundations to beyond the opposite edge of pavement terminating in a No. 7 pull box with extension. No pull box in the median barrier is required; however, the conduit shall extend a minimum of two inches above the top of the foundation and be plugged. If non-intrusive detection system technology is required

on a project, the FMS designer needs to coordinate with the ADOT TTG PM on the type of detection system to be implemented.

5.1.2 Retrofit Projects

Non-intrusive detection system technology has been the preferred retrofit detection system technology for replacing defective or out-of-place (due to restriping) pre-existing loops. Saw-cut loops in existing pavement may be considered only if approved by the ADOT TTG. If existing loops are being used for a project, it is the designer's responsibility to test the existing loops to ensure the loops are not damaged.

If the designer is working on the retrofit of an existing roadway or a restriping project on the roadway, it may be necessary to saw-cut loop detectors in the pavement surface. Typically, when a six-foot, square-shaped loop is centered in the lane, there is approximately three feet to the lane line. In a retrofit or restriping project, if the lane line shifts such that the edge of the buried loop is less than 18 inches from the new lane line, then new saw-cut loop detectors in the pavement surface or above-roadway detection systems are required. Each set of detector loops shall consist of two 6-foot, square-shaped loops per lane, separated longitudinally by 12 feet. Each saw-cut loop consists of four turns.

The loops are to be centered in the middle lane(s) and may be offset by one foot toward the shoulder in the lanes adjacent to the inside and outside shoulders. Loop detectors should be offset in the lanes adjacent to shoulders since the drivers of vehicles tend to shy toward the shoulder rather than to the adjacent lane because there is more pavement width for the driver to maneuver their vehicle in their lane plus the adjacent shoulder. However, where a future lane is planned adjacent to outside lanes, it is preferable to position the loop in the middle of the lane to anticipate the ultimate condition. Typical loop placements are shown in the FMS Standard Drawings. Auxiliary lane and high-occupancy-vehicle (HOV) lanes must have loop detectors installed similarly to general-purpose lanes.

Refer to the *FMS Standard Drawings* for further details, including:

- Typical loop placements beneath jointed concrete pavements (including pavements with load transfer dowel assemblies and the more typical plain concrete pavement); and
- Typical loop placements for saw-cut loops in asphalt and concrete pavements.

5.1.3 Loop Detector Requirements

Loop detector requirements are discussed in the *ADOT Standard Specifications for Road and Bridge Construction (*Sections 732 & 735), the *ADOT Ramp Meter Design, Operations, and Maintenance Guidelines,* and the *FMS Standard Specifications*. The typical loop labeling and loop wire path scheme is shown in Figure 5.1. Off ramp detectors are no longer installed except at system interchanges.

The following procedure is to be utilized for systematic design of the placement of mainline detector stations.

1. The location of the detector station upstream of the nose of the gore should not be greater than 400 feet or less than ten feet from the back of gore.
2. Proceed to the next downstream interchange and repeat the process.
3. Detector stations are to be located at a spacing of approximately one mile between the locations identified in steps 1 and 2.
4. Uniformity in loop detector spacing is desired; therefore, divide the distance between the locations identified in steps 1 and 2 into approximately equal one-mile segments and identify

these points as the location(s) of the intermediate stations. If a location falls on a bridge or in a lane taper, the loop location should be adjusted so that it is beyond the nearest bridge abutment or upstream of the start of a lane taper. When an adjustment is required, the loop spacing should be no more than one mile from any adjacent loop detector station.

The designer should be aware of the difficulties of obtaining accurate mainline count, occupancy, vehicle identification, and vehicle length data in the immediate vicinity of entrance and exit ramps due to the number of merging vehicles and lane changes which commonly occur. Where possible, the designer should avoid placing mainline detector stations where merging or extensive weaving occurs.

5. At least one loop detector station should be placed in each one-mile section of freeway.
6. Detector stations at system interchanges (SI) will be located to count each ramp. Each ramp will require two detector stations, one near the merge and another set of detectors at the diverge point of each ramp.
7. Repeat the process for the other direction of travel.

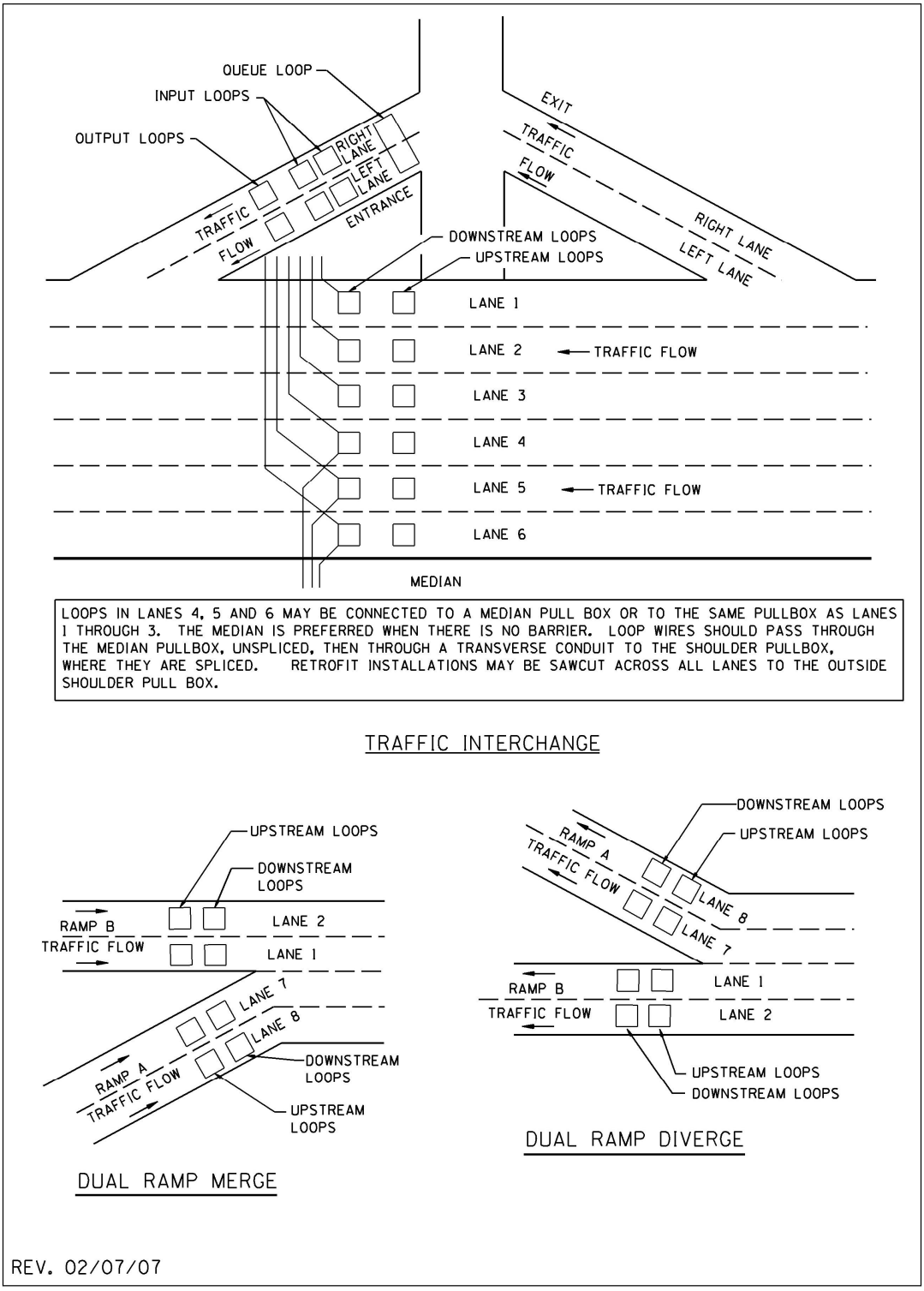

Figure 5.1 Loop Detector